

Jersey 2.0-m13 User Guide

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Preface

This is user guide for Jersey 2.0-m13. We are trying to keep it up to date as we add new feature. Please use also our API documentation linked from the Jersey home page [<http://jersey.java.net>] as an additional source of information about Jersey features and API. If you would like to contribute to the guide or have questions on things not covered in our docs, please contact us at users@jersey.java.net [<mailto:users@jersey.java.net>].

Chapter 1. Getting Started

This chapter provides a quick introduction on how to get started building RESTful services using Jersey. The example described here uses the lightweight Grizzly HTTP server. At the end of this chapter you will see how to implement equivalent functionality as a JavaEE web application you can deploy on any servlet container supporting Servlet 2.5 and higher.

1.1. Creating a New Project from Maven Archetype

If you want to depend on Jersey snapshot versions the following repository needs to be added to the pom:

```
<repository>
  <id>snapshot-repository.java.net</id>
  <name>Java.net Snapshot Repository for Maven</name>
  <url>https://maven.java.net/content/repositories/snapshots/</url>
  <layout>default</layout>
</repository>
```

Now, to create a new Jersey project, based on Grizzly 2 container, from a maven archetype, execute the following in the directory where the new project should reside:

```
mvn archetype:generate -DarchetypeArtifactId=jersey-quickstart-grizzly2 -DarchetypeGroupId=org.glassfish.jersey.quickstart
```

Feel free to adjust the group id, package name and artifact id of your new project in the line above, or you can change it after it gets generated by updating the project pom.xml

1.2. Exploring the Newly Created Project

TODO

1.3. Customizing the JAX-RS Resource

TODO: instructions on how to make simple edits to the newly created resource

1.4. Running the Project

TODO: instructions on how to run the project

1.5. Creating a JavaEE Web Application

TODO

1.6. Exploring Other Jersey Examples

Jersey codebase contains a number of useful samples on how to use various JAX-RS and Jersey features. Please refer to the [TODO: Examples] section of this guide for more information on those.

Chapter 2. Jersey Modules and Dependencies

Jersey is built, assembled and installed using Maven. Jersey is deployed to the Java.Net maven repository at the following location: <http://maven.java.net/> [<https://maven.java.net/index.html>]. The Jersey modules can be browsed at the following location: <https://maven.java.net/content/repositories/releases/org/glassfish/jersey>. Jars, Jar sources, Jar JavaDoc and samples are all available on the java.net maven repository.

An application depending on Jersey requires that it in turn includes the set of jars that Jersey depends on. Jersey has a pluggable component architecture so the set of jars required to be include in the class path can be different for each application.

All Jersey components are built using Java SE 6 compiler. It means, you will also need at least Java SE 6 to be able to compile and run your application.

Developers using maven are likely to find it easier to include and manage dependencies of their applications than developers using ant or other build technologies. This document will explain to both maven and non-maven developers how to depend on Jersey for their application. Ant developers are likely to find the Ant Tasks for Maven [<http://maven.apache.org/ant-tasks/index.html>] very useful.

The following table provides an overview of all Jersey modules and their dependencies with links to the respective binaries.

Table 2.1. Jersey modules and dependencies

Module	Dependencies	Description
Core		
jersey-server	jersey-commons	Base server functionality.
jersey-client	jersey-commons	Basic client functionality.
jersey-commons		Common functionality shared by client and server.
Containers		
...

2.1. Sample Scenarios

2.1.1. Basic Server-Side Application

For a server side Jersey application you typically need to depend on jersey-server module to provide the basic functionality, then you may want to support JSON mapping and a standard JavaEE servlet container you would deploy your application to. So this would be the common set of dependencies for your project for this kind of scenario:

- jersey-server
- jersey-commons
- ...

Chapter 3. JAX-RS Application, Resources and Sub-Resources

This chapter presents an overview of the core JAX-RS concepts - resources and sub-resources.

The JAX-RS 2.0-SNAPSHOT JavaDoc can be found online here [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/index.html>].

The JAX-RS 2.0-SNAPSHOT specification draft can be found online here [<http://jcp.org/en/jsr/summary?id=339>].

3.1. Root Resource Classes

Root resource classes are POJOs (Plain Old Java Objects) that are annotated with `@Path` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Path.html>] have at least one method annotated with `@Path` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Path.html>] or a resource method designator annotation such as `@GET` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/GET.html>], `@PUT` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/PUT.html>], `@POST` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/POST.html>], `@DELETE` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/DELETE.html>]. Resource methods are methods of a resource class annotated with a resource method designator. This section shows how to use Jersey to annotate Java objects to create RESTful web services.

The following code example is a very simple example of a root resource class using JAX-RS annotations. The example code shown here is from one of the samples that ships with Jersey, the zip file of which can be found in the maven repository here [<https://maven.java.net/service/local/artifact/maven/redirect?r=releases&g=org.glassfish.jersey.examples&a=helloworld&v=2.0-m13&c=project&e=zip>].

Example 3.1. Simple hello world root resource class

```
1 package org.glassfish.jersey.examples.helloworld;
2
3 import javax.ws.rs.GET;
4 import javax.ws.rs.Path;
5 import javax.ws.rs.Produces;
6
7 @Path("helloworld")
8 public class HelloWorldResource {
9     public static final String CLICHED_MESSAGE = "Hello World!";
10
11     @GET
12     @Produces("text/plain")
13     public String getHello() {
14         return CLICHED_MESSAGE;
15     }
16 }
```

Let's look at some of the JAX-RS annotations used in this example.

3.1.1. @Path

The `@Path` [http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Path.html] annotation's value is a relative URI path. In the example above, the Java class will be hosted at the URI path `/helloworld`. This is an extremely simple use of the `@Path` [http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Path.html] annotation. What makes JAX-RS so useful is that you can embed variables in the URIs.

URI path templates are URIs with variables embedded within the URI syntax. These variables are substituted at runtime in order for a resource to respond to a request based on the substituted URI. Variables are denoted by curly braces. For example, look at the following `@Path` [http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Path.html] annotation:

```
@Path("/users/{username}")
```

In this type of example, a user will be prompted to enter their name, and then a Jersey web service configured to respond to requests to this URI path template will respond. For example, if the user entered their username as "Galileo", the web service will respond to the following URL: `http://example.com/users/Galileo`

To obtain the value of the username variable the `@PathParam` [http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/PathParam.html] may be used on method parameter of a request method, for example:

Example 3.2. Specifying URI path parameter

```
1 @Path("/users/{username}")
2 public class UserResource {
3
4     @GET
5     @Produces("text/xml")
6     public String getUser(@PathParam("username") String userName) {
7         ...
8     }
9 }
```

If it is required that a user name must only consist of lower and upper case numeric characters then it is possible to declare a particular regular expression, which overrides the default regular expression, `"[/]+?"`, for example:

```
@Path("users/{username: [a-zA-Z][a-zA-Z_0-9]*}")
```

In this type of example the username variable will only match user names that begin with one upper or lower case letter and zero or more alpha numeric characters and the underscore character. If a user name does not match that a 404 (Not Found) response will occur.

A `@Path` [http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Path.html] value may or may not begin with a '/', it makes no difference. Likewise, by default, a `@Path` [http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Path.html] value may or may not end in a '/', it makes no difference, and thus request URLs that end or do not end in a '/' will both be matched.

3.1.2. @GET, @PUT, @POST, @DELETE, ... (HTTP Methods)

`@GET` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/GET.html>], `@PUT` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/PUT.html>], `@POST` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/POST.html>], `@DELETE` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/DELETE.html>] and `@HEAD` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/HEAD.html>] are *resource method designator* annotations defined by JAX-RS and which correspond to the similarly named HTTP methods. In the example above, the annotated Java method will process HTTP GET requests. The behavior of a resource is determined by which of the HTTP methods the resource is responding to.

The following example is an extract from the storage service sample that shows the use of the PUT method to create or update a storage container:

Example 3.3. PUT method

```
1 @PUT
2 public Response putContainer() {
3     System.out.println("PUT CONTAINER " + container);
4
5     URI uri = uriInfo.getAbsolutePath();
6     Container c = new Container(container, uri.toString());
7
8     Response r;
9     if (!MemoryStore.MS.hasContainer(c)) {
10         r = Response.created(uri).build();
11     } else {
12         r = Response.noContent().build();
13     }
14
15     MemoryStore.MS.createContainer(c);
16     return r;
17 }
```

By default the JAX-RS runtime will automatically support the methods HEAD and OPTIONS, if not explicitly implemented. For HEAD the runtime will invoke the implemented GET method (if present) and ignore the response entity (if set). For OPTIONS the Allow response header will be set to the set of HTTP methods support by the resource. In addition Jersey will return a WADL [<http://wadl.java.net/>] document describing the resource.

3.1.3. @Produces

The `@Produces` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Produces.html>] annotation is used to specify the MIME media types of representations a resource can produce and send back to the client. In this example, the Java method will produce representations identified by the MIME media type "text/plain". `@Produces` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Produces.html>] can be applied at both the class and method levels. Here's an example:

Example 3.4. Specifying output MIME type

```
1 @Path("/myResource")
2 @Produces("text/plain")
3 public class SomeResource {
4     @GET
5     public String doGetAsPlainText() {
6         ...
7     }
8
9     @GET
10    @Produces("text/html")
11    public String doGetAsHtml() {
12        ...
13    }
14 }
```

The `doGetAsPlainText` method defaults to the MIME type of the `@Produces` [http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Produces.html] annotation at the class level. The `doGetAsHtml` method's `@Produces` [http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Produces.html] annotation overrides the class-level `@Produces` [http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Produces.html] setting, and specifies that the method can produce HTML rather than plain text.

If a resource class is capable of producing more than one MIME media type then the resource method chosen will correspond to the most acceptable media type as declared by the client. More specifically the Accept header of the HTTP request declared what is most acceptable. For example if the Accept header is "Accept: text/plain" then the `doGetAsPlainText` method will be invoked. Alternatively if the Accept header is "Accept: text/plain;q=0.9, text/html", which declares that the client can accept media types of "text/plain" and "text/html" but prefers the latter, then the `doGetAsHtml` method will be invoked.

More than one media type may be declared in the same `@Produces` [http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Produces.html] declaration, for example:

Example 3.5. Using multiple output MIME types

```
1 @GET
2 @Produces({"application/xml", "application/json"})
3 public String doGetAsXmlOrJson() {
4     ...
5 }
```

The `doGetAsXmlOrJson` method will get invoked if either of the media types "application/xml" and "application/json" are acceptable. If both are equally acceptable then the former will be chosen because it occurs first.

Optionally, server can also specify the quality factor for individual media types. These are considered if several are equally acceptable by the client. For example:

Example 3.6. Server-side content negotiation

```
1 @GET
2 @Produces({ "application/xml; qs=0.9", "application/json" })
3 public String doGetAsXmlOrJson() {
4     ...
5 }
```

In the above sample, if client accepts both "application/xml" and "application/json" (equally), then server always sends "application/json", since "application/xml" has a lower quality factor.

The examples above refer explicitly to MIME media types for clarity. It is possible to refer to constant values, which may reduce typographical errors, see the constant field values of `MediaType` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/MediaType.html>].

3.1.4. @Consumes

The `@Consumes` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Consumes.html>] annotation is used to specify the MIME media types of representations a resource can consume that were sent by the client. The above example can be modified to set the cliched message as follows:

Example 3.7. Specifying input MIME type

```
1 @POST
2 @Consumes("text/plain")
3 public void postClichedMessage(String message) {
4     // Store the message
5 }
```

In this example, the Java method will consume representations identified by the MIME media type "text/plain". Notice that the resource method returns void. This means no representation is returned and response with a status code of 204 (No Content) will be returned.

`@Consumes` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Consumes.html>] can be applied at both the class and the method levels and more than one media type may be declared in the same `@Consumes` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Consumes.html>] declaration.

3.2. Parameter Annotations (@*Param)

Parameters of a resource method may be annotated with parameter-based annotations to extract information from a request. One of the previous examples presented the use of `@PathParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/PathParam.html>] to extract a path parameter from the path component of the request URL that matched the path declared in `@Path` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Path.html>].

`@QueryParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/QueryParam.html>] is used to extract query parameters from the Query component of the request URL. The following example is an extract from the sparklines sample:

Example 3.8. Query parameters

```
1 @Path("smooth")
2 @GET
3 public Response smooth(
4     @DefaultValue("2") @QueryParam("step") int step,
5     @DefaultValue("true") @QueryParam("min-m") boolean hasMin,
6     @DefaultValue("true") @QueryParam("max-m") boolean hasMax,
7     @DefaultValue("true") @QueryParam("last-m") boolean hasLast,
8     @DefaultValue("blue") @QueryParam("min-color") ColorParam minColor,
9     @DefaultValue("green") @QueryParam("max-color") ColorParam maxColor,
10    @DefaultValue("red") @QueryParam("last-color") ColorParam lastColor
11    ) { ... }
```

If a query parameter "step" exists in the query component of the request URI then the "step" value will be extracted and parsed as a 32 bit signed integer and assigned to the step method parameter. If "step" does not exist then a default value of 2, as declared in the `@DefaultValue` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/DefaultValue.html>] annotation, will be assigned to the step method parameter. If the "step" value cannot be parsed as a 32 bit signed integer then a HTTP 404 (Not Found) response is returned. User defined Java types such as `ColorParam` may be used, which as implemented as follows:

Example 3.9. Custom Java type for consuming request parameters

```
1 public class ColorParam extends Color {
2     public ColorParam(String s) {
3         super(getRGB(s));
4     }
5
6     private static int getRGB(String s) {
7         if (s.charAt(0) == '#') {
8             try {
9                 Color c = Color.decode("0x" + s.substring(1));
10                return c.getRGB();
11            } catch (NumberFormatException e) {
12                throw new WebApplicationException(400);
13            }
14        } else {
15            try {
16                Field f = Color.class.getField(s);
17                return ((Color)f.get(null)).getRGB();
18            } catch (Exception e) {
19                throw new WebApplicationException(400);
20            }
21        }
22    }
23 }
```

In general the Java type of the method parameter may:

1. Be a primitive type;
2. Have a constructor that accepts a single String argument;

3. Have a static method named `valueOf` or `fromString` that accepts a single `String` argument (see, for example, `Integer.valueOf(String)` and `java.util.UUID.fromString(String)`); or
4. Be `List<T>`, `Set<T>` or `SortedSet<T>`, where `T` satisfies 2 or 3 above. The resulting collection is read-only.

Sometimes parameters may contain more than one value for the same name. If this is the case then types in 4) may be used to obtain all values.

If the `@DefaultValue` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/DefaultValue.html>] is not used in conjunction with `@QueryParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/QueryParam.html>] and the query parameter is not present in the request then value will be an empty collection for `List`, `Set` or `SortedSet`, `null` for other object types, and the Java-defined default for primitive types.

The `@PathParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/PathParam.html>] and the other parameter-based annotations, `@MatrixParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/MatrixParam.html>], `@HeaderParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/HeaderParam.html>], `@CookieParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/CookieParam.html>], `@FormParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/FormParam.html>] obey the same rules as `@QueryParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/QueryParam.html>]. `@MatrixParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/MatrixParam.html>] extracts information from URL path segments. `@HeaderParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/HeaderParam.html>] extracts information from the HTTP headers. `@CookieParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/CookieParam.html>] extracts information from the cookies declared in cookie related HTTP headers.

`@FormParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/FormParam.html>] is slightly special because it extracts information from a request representation that is of the MIME media type `"application/x-www-form-urlencoded"` and conforms to the encoding specified by HTML forms, as described here. This parameter is very useful for extracting information that is POSTed by HTML forms, for example the following extracts the form parameter named `"name"` from the POSTed form data:

Example 3.10. Processing POSTed HTML form

```
1 @POST
2 @Consumes("application/x-www-form-urlencoded")
3 public void post(@FormParam("name") String name) {
4     // Store the message
5 }
```

If it is necessary to obtain a general map of parameter name to values then, for query and path parameters it is possible to do the following:

Example 3.11. Obtaining general map of URI path and/or query parameters

```
1 @GET
2 public String get(@Context UriInfo ui) {
3     MultivaluedMap<String, String> queryParams = ui.getQueryParameters();
4     MultivaluedMap<String, String> pathParams = ui.getPathParameters();
5 }
```


For header and cookie parameters the following:

Example 3.12. Obtaining general map of header parameters

```
1 @GET
2 public String get(@Context HttpHeaders hh) {
3     MultivaluedMap<String, String> headerParams = hh.getRequestHeaders();
4     Map<String, Cookie> pathParams = hh.getCookies();
5 }
```

In general `@Context` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Context.html>] can be used to obtain contextual Java types related to the request or response.

Because form parameters (unlike others) are part of the message entity, it is possible to do the following:

Example 3.13. Obtaining general map of form parameters

```
1 @POST
2 @Consumes("application/x-www-form-urlencoded")
3 public void post(MultivaluedMap<String, String> formParams) {
4     // Store the message
5 }
```

I.e. you don't need to use the `@Context` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Context.html>] annotation.

Another kind of injection is the `@BeanParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/BeanParam.html>] which allows to inject the parameters described above into a single bean. A bean annotated with `@BeanParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/BeanParam.html>] containing any fields and appropriate `*param` annotation (like `@PathParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/PathParam.html>]) will be initialized with corresponding request values in expected way as if these fields were in the resource class. Then instead of injecting request values like path param in constructor parameters or class fields the `@BeanParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/BeanParam.html>] can be used to inject such a bean into a resource or resource method. The `@BeanParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/BeanParam.html>] is used this way to aggregate more request parameters into a single bean.

Example 3.14. Example of the bean which will be used as `@BeanParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/BeanParam.html>]

```
1
2 public class MyBeanParam {
3     @PathParam("p")
4     private String pathParam;
5
6     @MatrixParam("m")
7     @Encoded
8     @DefaultValue("default")
9     private String matrixParam;
10
11    @HeaderParam("header")
12    private String headerParam;
13
14    private String queryParams;
15
16    public MyBeanParam(@QueryParam("q") String queryParams) {
17        this.queryParams = queryParams;
18    }
19
20    public String getPathParam() {
21        return pathParam;
22    }
23    ...
24 }
25
```

Example 3.15. Injection of `MyBeanParam` as a method parameter:

```
1
2 @POST
3 public void post(@BeanParam MyBeanParam beanParam, String entity) {
4     final String pathParam = beanParam.getPathParam(); // contains injected pa
5     ...
6 }
7
```

The example shows aggregation of injections `@PathParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/PathParam.html>], `@QueryParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/QueryParam.html>] `@MatrixParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/MatrixParam.html>] and `@HeaderParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/HeaderParam.html>] into one single bean. The rules for injections inside the bean are the same as described above for these injections. The `@DefaultValue` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/DefaultValue.html>] is used to define the default value for matrix parameter `matrixParam`. Also the `@Encoded` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Encoded.html>] annotation has the same behaviour as if it were used for injection in the resource method directly. Injecting the bean parameter into `@Singleton` resource class fields is not allowed (injections into method parameter must be used instead).

`@BeanParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/BeanParam.html>] can contain all parameters injections injections (`@PathParam` [[---

11](http://jax-rs-spec.java.net/nonav/2.0-</p></div><div data-bbox=)

SNAPSHOT/apidocs/javax/ws/rs/PathParam.html], @QueryParam [http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/QueryParam.html], @MatrixParam [http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/MatrixParam.html], @HeaderParam [http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/HeaderParam.html], @CookieParam [http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/CookieParam.html], @FormParam [http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/FormParam.html]). More beans can be injected into one resource or method parameters even if they inject the same request values. For example the following is possible:

Example 3.16. Injection of more beans into one resource methods:

```
1
2 @POST
3 public void post(@BeanParam MyBeanParam beanParam, @BeanParam AnotherBean anot
4 String entity) {
5     // beanParam.getPathParam() == pathParam
6     ...
7 }
8
```

3.3. Sub-resources

@Path [http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Path.html] may be used on classes and such classes are referred to as root resource classes. @Path [http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Path.html] may also be used on methods of root resource classes. This enables common functionality for a number of resources to be grouped together and potentially reused.

The first way @Path [http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Path.html] may be used is on resource methods and such methods are referred to as *sub-resource methods*. The following example shows the method signatures for a root resource class from the jmaki-backend sample:

Example 3.17. Sub-resource methods

```
1 @Singleton
2 @Path("/printers")
3 public class PrintersResource {
4
5     @GET
6     @Produces({"application/json", "application/xml"})
7     public WebResourceList getMyResources() { ... }
8
9     @GET @Path("/list")
10    @Produces({"application/json", "application/xml"})
11    public WebResourceList getListOfPrinters() { ... }
12
13    @GET @Path("/jMakiTable")
14    @Produces("application/json")
15    public PrinterTableModel getTable() { ... }
16
17    @GET @Path("/jMakiTree")
18    @Produces("application/json")
19    public TreeModel getTree() { ... }
20
21    @GET @Path("/ids/{printerid}")
22    @Produces({"application/json", "application/xml"})
23    public Printer getPrinter(@PathParam("printerid") String printerId) { ... }
24
25    @PUT @Path("/ids/{printerid}")
26    @Consumes({"application/json", "application/xml"})
27    public void putPrinter(@PathParam("printerid") String printerId, Printer
28
29    @DELETE @Path("/ids/{printerid}")
30    public void deletePrinter(@PathParam("printerid") String printerId) { ... }
31 }
```

If the path of the request URL is "printers" then the resource methods not annotated with `@Path` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Path.html>] will be selected. If the request path of the request URL is "printers/list" then first the root resource class will be matched and then the sub-resource methods that match "list" will be selected, which in this case is the sub-resource method `getListOfPrinters`. So in this example hierarchical matching on the path of the request URL is performed.

The second way `@Path` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Path.html>] may be used is on methods **not** annotated with resource method designators such as `@GET` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/GET.html>] or `@POST` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/POST.html>]. Such methods are referred to as *sub-resource locators*. The following example shows the method signatures for a root resource class and a resource class from the optimistic-concurrency sample:

Example 3.18. Sub-resource locators

```
1 @Path("/item")
2 public class ItemResource {
3     @Context UriInfo uriInfo;
4
5     @Path("content")
6     public ItemContentResource getItemContentResource() {
7         return new ItemContentResource();
8     }
9
10    @GET
11    @Produces("application/xml")
12    public Item get() { ... }
13 }
14
15 public class ItemContentResource {
16
17     @GET
18     public Response get() { ... }
19
20     @PUT
21     @Path("{version}")
22     public void put(
23         @PathParam("version") int version,
24         @Context HttpHeaders headers,
25         byte[] in) { ... }
26 }
```

The root resource class `ItemResource` contains the sub-resource locator method `getItemContentResource` that returns a new resource class. If the path of the request URL is "item/content" then first of all the root resource will be matched, then the sub-resource locator will be matched and invoked, which returns an instance of the `ItemContentResource` resource class. Sub-resource locators enable reuse of resource classes.

In addition the processing of resource classes returned by sub-resource locators is performed at runtime thus it is possible to support polymorphism. A sub-resource locator may return different sub-types depending on the request (for example a sub-resource locator could return different sub-types dependent on the role of the principle that is authenticated).

Note that the runtime will not manage the life-cycle or perform any field injection onto instances returned from sub-resource locator methods. This is because the runtime does not know what the life-cycle of the instance is.

3.4. Life-cycle of Root Resource Classes

By default the life-cycle of root resource classes is per-request, namely that a new instance of a root resource class is created every time the request URI path matches the root resource. This makes for a very natural programming model where constructors and fields can be utilized (as in the previous section showing the constructor of the `SparklinesResource` class) without concern for multiple concurrent requests to the same resource.

In general this is unlikely to be a cause of performance issues. Class construction and garbage collection of JVMs has vastly improved over the years and many objects will be created and discarded to serve and process the HTTP request and return the HTTP response.

Instances of singleton root resource classes can be declared by an instance of Application [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Application.html>].

Jersey supports two further life-cycles using Jersey specific annotations. If a root resource class is annotated with `@Singleton` then only one instance is created per-web application. If a root resource class is annotated with `@PerSession` then one instance is created per web session and stored as a session attribute.

3.5. Rules of Injection

Previous sections have presented examples of annotated types, mostly annotated method parameters but also annotated fields of a class, for the injection of values onto those types.

This section presents the rules of injection of values on annotated types. Injection can be performed on fields, constructor parameters, resource/sub-resource/sub-resource locator method parameters and bean setter methods. The following presents an example of all such injection cases:

Example 3.19. Injection

```
1 @Path("id: \d+")
2 public class InjectedResource {
3     // Injection onto field
4     @DefaultValue("q") @QueryParam("p")
5     private String p;
6
7     // Injection onto constructor parameter
8     public InjectedResource(@PathParam("id") int id) { ... }
9
10    // Injection onto resource method parameter
11    @GET
12    public String get(@Context UriInfo ui) { ... }
13
14    // Injection onto sub-resource resource method parameter
15    @Path("sub-id")
16    @GET
17    public String get(@PathParam("sub-id") String id) { ... }
18
19    // Injection onto sub-resource locator method parameter
20    @Path("sub-id")
21    public SubResource getSubResource(@PathParam("sub-id") String id) { ... }
22
23    // Injection using bean setter method
24    @HeaderParam("X-header")
25    public void setHeader(String header) { ... }
26 }
```

There are some restrictions when injecting on to resource classes with a life-cycle other than per-request. In such cases it is not possible to inject onto fields for the annotations associated with extraction of request parameters. However, it is possible to use the `@Context` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Context.html>] annotation on fields, in such cases a thread local proxy will be injected.

The `@FormParam` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/FormParam.html>] annotation is special and may only be utilized on resource and sub-resource methods. This is because it extracts information from a request entity.

3.6. Use of @Context

Previous sections have introduced the use of @Context [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Context.html>]. Chapter 5 of the JAX-RS specification presents all the standard JAX-RS Java types that may be used with @Context [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Context.html>].

When deploying a JAX-RS application using servlet then ServletConfig [<http://docs.oracle.com/javaee/5/api/javax/servlet/ServletConfig.html>], ServletContext [<http://docs.oracle.com/javaee/5/api/javax/servlet/ServletContext.html>], HttpServletRequest [<http://docs.oracle.com/javaee/5/api/javax/servlet/http/HttpServletRequest.html>] and HttpServletResponse [<http://docs.oracle.com/javaee/5/api/javax/servlet/http/HttpServletResponse.html>] are available using @Context [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Context.html>].

Chapter 4. Representations and Responses

4.1. Representations and Java Types

Previous sections on `@Produces` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Produces.html>] and `@Consumes` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Consumes.html>] referred to MIME media types of representations and showed resource methods that consume and produce the Java type `String` for a number of different media types. However, `String` is just one of many Java types that are required to be supported by JAX-RS implementations.

Java types such as `byte[]`, `java.io.InputStream`, `java.io.Reader` and `java.io.File` are supported. In addition JAXB beans are supported. Such beans are `JAXBElement` or classes annotated with `@XmlRootElement` [<http://docs.oracle.com/javase/6/docs/api/javax/xml/bind/annotation/XmlRootElement.html>] or `@XmlType` [<http://docs.oracle.com/javase/6/docs/api/javax/xml/bind/annotation/XmlType.html>]. The samples `jaxb` and `json-from-jaxb` show the use of JAXB beans.

Unlike method parameters that are associated with the extraction of request parameters, the method parameter associated with the representation being consumed does not require annotating. A maximum of one such unannotated method parameter may exist since there may only be a maximum of one such representation sent in a request.

The representation being produced corresponds to what is returned by the resource method. For example JAX-RS makes it simple to produce images that are instance of `File` as follows:

Example 4.1. Using `File` with a specific MIME type to produce a response

```
1 @GET
2 @Path("/images/{image}")
3 @Produces("image/*")
4 public Response getImage(@PathParam("image") String image) {
5     File f = new File(image);
6
7     if (!f.exists()) {
8         throw new WebApplicationException(404);
9     }
10
11     String mt = new MimetypesFileTypeMap().getContentType(f);
12     return Response.ok(f, mt).build();
13 }
```

A `File` type can also be used when consuming, a temporary file will be created where the request entity is stored.

The `Content-Type` (if not set, see next section) can be automatically set from the MIME media types declared by `@Produces` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/Produces.html>] if the most acceptable media type is not a wild card (one that contains a `*`, for example `"application/"` or `"/*"`). Given the following method, the most acceptable MIME type is used when multiple output MIME types allowed:

```
1 @GET
```



```
2 @Produces({"application/xml", "application/json"})
3 public String doGetAsXmlOrJson() {
4     ...
5 }
```

If "application/xml" is the most acceptable then the `Content-Type` of the response will be set to "application/xml".

4.2. Building Responses

Sometimes it is necessary to return additional information in response to a HTTP request. Such information may be built and returned using `Response` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Response.html>] and `Response.ResponseBuilder` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Response.ResponseBuilder.html>]. For example, a common RESTful pattern for the creation of a new resource is to support a POST request that returns a 201 (Created) status code and a `Location` header whose value is the URI to the newly created resource. This may be achieved as follows:

Example 4.2. Returning 201 status code and adding `Location` header in response to POST request

```
1 @POST
2 @Consumes("application/xml")
3 public Response post(String content) {
4     URI createdUri = ...
5     create(content);
6     return Response.created(createdUri).build();
7 }
```

In the above no representation produced is returned, this can be achieved by building an entity as part of the response as follows:

Example 4.3. Adding an entity body to a custom response

```
1 @POST
2 @Consumes("application/xml")
3 public Response post(String content) {
4     URI createdUri = ...
5     String createdContent = create(content);
6     return Response.created(createdUri).entity(createdContent).build();
7 }
```

Response building provides other functionality such as setting the entity tag and last modified date of the representation.

4.3. `WebApplicationException` and Mapping Exceptions to Responses

Previous sections have shown how to return HTTP responses and it is possible to return HTTP errors using the same mechanism. However, sometimes when programming in Java it is more natural to use exceptions for HTTP errors.

The following example shows the throwing of a `NotFoundException` from the bookmark sample:

Example 4.4. Throwing Jersey specific exceptions to control response

```
1 @Path("items/{itemid}/")
2 public Item getItem(@PathParam("itemid") String itemid) {
3     Item i =.getItems().get(itemid);
4     if (i == null)
5         throw new NotFoundException("Item, " + itemid + ", is not found");
6
7     return i;
8 }
```

This exception is a Jersey specific exception that extends `WebApplicationException` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/WebApplicationException.html>] and builds a HTTP response with the 404 status code and an optional message as the body of the response:

Example 4.5. Jersey specific exception implementation

```
1 public class NotFoundException extends WebApplicationException {
2
3     /**
4      * Create a HTTP 404 (Not Found) exception.
5      */
6     public NotFoundException() {
7         super(Responses.notFound().build());
8     }
9
10    /**
11     * Create a HTTP 404 (Not Found) exception.
12     * @param message the String that is the entity of the 404 response.
13     */
14    public NotFoundException(String message) {
15        super(Response.status(Responses.NOT_FOUND).
16                entity(message).type("text/plain").build());
17    }
18
19 }
```

In other cases it may not be appropriate to throw instances of `WebApplicationException` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/WebApplicationException.html>], or classes that extend `WebApplicationException` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/WebApplicationException.html>], and instead it may be preferable to map an existing exception to a response. For such cases it is possible to use the `ExceptionHandler` [http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/ext/ExceptionHandler.html] interface. For example, the following maps the `EntityNotFoundException` [<http://docs.oracle.com/javaee/5/api/javax/persistence/EntityNotFoundException.html>] to a HTTP 404 (Not Found) response:

Example 4.6. Mapping generic exceptions to responses

```
1 @Provider
2 public class EntityNotFoundMapper implements
3     ExceptionMapper<javax.persistence.EntityNotFoundException> {
4     public Response toResponse(javax.persistence.EntityNotFoundException ex) {
5         return Response.status(404).
6             entity(ex.getMessage()).
7             type("text/plain").
8             build();
9     }
10 }
```

The above class is annotated with `@Provider` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/ext/Provider.html>], this declares that the class is of interest to the JAX-RS runtime. Such a class may be added to the set of classes of the Application [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Application.html>] instance that is configured. When an application throws an `EntityNotFoundException` [<http://docs.oracle.com/javaee/5/api/javax/persistence/EntityNotFoundException.html>] the `toResponse` method of the `EntityNotFoundMapper` instance will be invoked.

4.4. Conditional GETs and Returning 304 (Not Modified) Responses

Conditional GETs are a great way to reduce bandwidth, and potentially server-side performance, depending on how the information used to determine conditions is calculated. A well-designed web site may return 304 (Not Modified) responses for the many of the static images it serves.

JAX-RS provides support for conditional GETs using the contextual interface `Request` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Request.html>].

The following example shows conditional GET support from the sparklines sample:

Example 4.7. Conditional GET support

```
1 public SparklinesResource(  
2     @QueryParam("d") IntegerList data,  
3     @DefaultValue("0,100") @QueryParam("limits") Interval limits,  
4     @Context Request request,  
5     @Context UriInfo ui) {  
6     if (data == null)  
7         throw new WebApplicationException(400);  
8  
9     this.data = data;  
10  
11    this.limits = limits;  
12  
13    if (!limits.contains(data))  
14        throw new WebApplicationException(400);  
15  
16    this.tag = computeEntityTag(ui.getRequestUri());  
17    if (request.getMethod().equals("GET")) {  
18        Response.ResponseBuilder rb = request.evaluatePreconditions(tag);  
19        if (rb != null)  
20            throw new WebApplicationException(rb.build());  
21    }  
22 }
```

The constructor of the `SparklinesResource` root resource class computes an entity tag from the request URI and then calls the `request.evaluatePreconditions` [[http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Request.html#evaluatePreconditions\(javax.ws.rs.core.EntityTag\)](http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Request.html#evaluatePreconditions(javax.ws.rs.core.EntityTag))] with that entity tag. If a client request contains an `If-None-Match` header with a value that contains the same entity tag that was calculated then the `evaluatePreconditions` [[http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Request.html#evaluatePreconditions\(javax.ws.rs.core.EntityTag\)](http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Request.html#evaluatePreconditions(javax.ws.rs.core.EntityTag))] returns a pre-filled out response, with the 304 status code and entity tag set, that may be built and returned. Otherwise, `evaluatePreconditions` [[http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Request.html#evaluatePreconditions\(javax.ws.rs.core.EntityTag\)](http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Request.html#evaluatePreconditions(javax.ws.rs.core.EntityTag))] returns null and the normal response can be returned.

Notice that in this example the constructor of a resource class can be used perform actions that may otherwise have to be duplicated to invoked for each resource method.

Chapter 5. URIs and Links

5.1. Building URIs

A very important aspects of REST is hyperlinks, URIs, in representations that clients can use to transition the Web service to new application states (this is otherwise known as "hypermedia as the engine of application state"). HTML forms present a good example of this in practice.

Building URIs and building them safely is not easy with `java.net.URI` [<http://docs.oracle.com/javase/1.5.0/docs/api/java/net/URI.html>], which is why JAX-RS has the `UriBuilder` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/UriBuilder.html>] class that makes it simple and easy to build URIs safely.

`UriBuilder` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/UriBuilder.html>] can be used to build new URIs or build from existing URIs. For resource classes it is more than likely that URIs will be built from the base URI the web service is deployed at or from the request URI. The class `UriInfo` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/UriInfo.html>] provides such information (in addition to further information, see next section).

The following example shows URI building with `UriInfo` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/UriInfo.html>] and `UriBuilder` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/UriBuilder.html>] from the bookmark sample:

Example 5.1. URI building

```
1 @Path("/users/")
2 public class UsersResource {
3
4     @Context UriInfo uriInfo;
5
6     ...
7
8     @GET
9     @Produces("application/json")
10    public JSONArray getUsersAsJsonArray() {
11        JSONArray uriArray = new JSONArray();
12        for (UserEntity userEntity : getUsers()) {
13            UriBuilder ub = uriInfo.getAbsolutePathBuilder();
14            URI userUri = ub.
15                path(userEntity.getUserid()).
16                build();
17            uriArray.put(userUri.toASCIIString());
18        }
19        return uriArray;
20    }
21 }
```

`UriInfo` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/UriInfo.html>] is obtained using the `@Context` annotation, and in this particular example injection onto the field of the root resource class is performed, previous examples showed the use of `@Context` on resource method parameters.

`UriInfo` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/UriInfo.html>] can be used to obtain URIs and associated `UriBuilder` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/>]

`apidocs/javax/ws/rs/core/UriBuilder.html`] instances for the following URIs: the base URI the application is deployed at; the request URI; and the absolute path URI, which is the request URI minus any query components.

The `getUsersAsJsonArray` method constructs a `JSONArray` where each element is a URI identifying a specific user resource. The URI is built from the absolute path of the request URI by calling `UriInfo.getAbsolutePathBuilder()` [`http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/UriInfo.html#getAbsolutePathBuilder()`]. A new path segment is added, which is the user ID, and then the URI is built. Notice that it is not necessary to worry about the inclusion of `'` characters or that the user ID may contain characters that need to be percent encoded. `UriBuilder` takes care of such details.

`UriBuilder` [`http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/UriBuilder.html`] can be used to build/replace query or matrix parameters. URI templates can also be declared, for example the following will build the URI `"http://localhost/segment?name=value"`:

Example 5.2. Building URIs using query parameters

```
1 UriBuilder.fromUri("http://localhost/").
2   path("{a}").
3   queryParams("name", "{value}").
4   build("segment", "value");
```

Chapter 6. Deploying a RESTful Web Service

JAX-RS provides a deployment agnostic abstract class `Application` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Application.html>] for declaring root resource and provider classes, and root resource and provider singleton instances. A Web service may extend this class to declare root resource and provider classes. For example,

Example 6.1. Deployment agnostic application model

```
1 public class MyApplication extends Application {
2     public Set<Class<?>> getClasses() {
3         Set<Class<?>> s = new HashSet<Class<?>>();
4         s.add(HelloWorldResource.class);
5         return s;
6     }
7 }
```

Alternatively it is possible to reuse one of Jersey's implementations that scans for root resource and provider classes given a classpath or a set of package names. Such classes are automatically added to the set of classes that are returned by `getClasses`. For example, the following scans for root resource and provider classes in packages "org.foo.rest", "org.bar.rest" and in any sub-packages of those two:

Example 6.2. Reusing Jersey implementation in your custom application model

```
1 public class MyApplication extends PackagesResourceConfig {
2     public MyApplication() {
3         super("org.foo.rest;org.bar.rest");
4     }
5 }
```

There are multiple deployment options for the class that implements `Application` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Application.html>] interface in the Servlet 3.0 container. For simple deployments, no `web.xml` is needed at all. Instead, an `@ApplicationPath` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/ApplicationPath.html>] annotation can be used to annotate the user defined application class and specify the the base resource URI of all application resources:

Example 6.3. Deployment of a JAX-RS application using `@ApplicationPath` with Servlet 3.0

```
1 @ApplicationPath("resources")
2 public class MyApplication extends PackagesResourceConfig {
3     public MyApplication() {
4         super("org.foo.rest;org.bar.rest");
5     }
6     ...
7 }
```

You also need to set `maven-war-plugin` attribute to `false` in `pom.xml` when building `.war` without `web.xml` file using maven:

Example 6.4. Configuration of maven-war-plugin in pom.xml with Servlet 3.0

```
1 <plugins>
2   ...
3   <plugin>
4     <groupId>org.apache.maven.plugins</groupId>
5     <artifactId>maven-war-plugin</artifactId>
6     <version>2.1.1</version>
7     <configuration>
8       <failOnMissingWebXml>false</failOnMissingWebXml>
9     </configuration>
10  </plugin>
11  ...
12 </plugins>
```

Another deployment option is to declare JAX-RS application details in the web.xml. This is usually suitable in case of more complex deployments, e.g. when security model needs to be properly defined or when additional initialization parameters have to be passed to Jersey runtime. JAX-RS 1.1 specifies that a fully qualified name of the class that implements Application [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Application.html>] may be declared in the <servlet-name> element of the JAX-RS application's web.xml. This is supported in a Web container implementing Servlet 3.0 as follows:

Example 6.5. Deployment of a JAX-RS application using web.xml with Servlet 3.0

```
1 <web-app>
2   <servlet>
3     <servlet-name>org.foo.rest.MyApplication</servlet-name>
4   </servlet>
5   ...
6   <servlet-mapping>
7     <servlet-name>org.foo.rest.MyApplication</servlet-name>
8     <url-pattern>/resources</url-pattern>
9   </servlet-mapping>
10  ...
11 </web-app>
```

Note that the <servlet-class> element is omitted from the servlet declaration. This is a correct declaration utilizing the Servlet 3.0 extension mechanism. Also note that <servlet-mapping> is used to define the base resource URI.

When running in a Servlet 2.x then instead it is necessary to declare the Jersey specific servlet and pass the Application [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Application.html>] implementation class name as one of the servlet's init-param entries:

Example 6.6. Deployment of your application using Jersey specific servlet

```
1 <web-app>
2     <servlet>
3         <servlet-name>Jersey Web Application</servlet-name>
4         <servlet-class>com.sun.jersey.spi.container.servlet.ServletContainer</
5         <init-param>
6             <param-name>javax.ws.rs.Application</param-name>
7             <param-value>org.foo.rest.MyApplication</param-value>
8         </init-param>
9         ...
10    </servlet>
11    ...
12 </web-app>
```

Alternatively a simpler approach is to let Jersey choose the `PackagesResourceConfig` implementation automatically by declaring the packages as follows:

Example 6.7. Using Jersey specific servlet without an application model instance

```
1 <web-app>
2     <servlet>
3         <servlet-name>Jersey Web Application</servlet-name>
4         <servlet-class>com.sun.jersey.spi.container.servlet.ServletContainer</
5         <init-param>
6             <param-name>com.sun.jersey.config.property.packages</param-name>
7             <param-value>org.foo.rest;org.bar.rest</param-value>
8         </init-param>
9         ...
10    </servlet>
11    ...
12 </web-app>
```

JAX-RS also provides the ability to obtain a container specific artifact from an Application [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Application.html>] instance. For example, Jersey supports using Grizzly [<http://grizzly.java.net/>] as follows:

```
SelectorThread st = RuntimeDelegate.createEndpoint(new MyApplication(), SelectorTh
```

Jersey also provides Grizzly [<http://grizzly.java.net/>] helper classes to deploy the `ServletThread` instance at a base URL for in-process deployment.

The Jersey samples provide many examples of Servlet-based and Grizzly-in-process-based deployments.

Chapter 7. Client API

This section introduces the JAX-RS Client API, which is a high-level Java based API for interoperating with RESTful Web services. It makes it very easy to interoperate with RESTful Web services and enables a developer to concisely and efficiently implement a reusable client-side solution that leverages existing and well established client-side HTTP implementations.

The client API can be utilized to interoperate with any RESTful Web service, implemented using one of many frameworks, and is not restricted to services implemented using JAX-RS. However, developers familiar with JAX-RS should find the client API complementary to their services, especially if the client API is utilized by those services themselves, or to test those services.

The goals of the client API are threefold:

1. Encapsulate a key constraint of the REST architectural style, namely the Uniform Interface Constraint and associated data elements, as client-side Java artifacts;
2. Make it as easy to interoperate with RESTful Web services as the JAX-RS server-side API makes it easy to build RESTful Web services; and
3. Share common concepts of the JAX-RS API between the server and the client side.

The Client API supports a pluggable architecture to enable the use of different underlying HTTP client implementations. Several such implementations are supported by Jersey. To name a few we have a client connectors for `Http(s)URLConnection` classes supplied with the JDK; and the Grizzly client.

7.1. Uniform Interface Constraint

The uniform interface constraint bounds the architecture of RESTful Web services so that a client, such as a browser, can utilize the same interface to communicate with any service. This is a very powerful concept in software engineering that makes Web-based search engines and service mash-ups possible. It induces properties such as:

1. simplicity, the architecture is easier to understand and maintain; and
2. modifiability or loose coupling, clients and services can evolve over time perhaps in new and unexpected ways, while retaining backwards compatibility.

Further constraints are required:

1. every resource is identified by a URI;
2. a client interacts with the resource via HTTP requests and responses using a fixed set of HTTP methods;
3. one or more representations can be returned and are identified by media types; and
4. the contents of which can link to further resources.

The above process repeated over and over again should be familiar to anyone who has used a browser to fill in HTML forms and follow links. That same process is applicable to non-browser based clients.

Many existing Java-based client APIs, such as the Apache HTTP client API or `java.net.HttpURLConnection` supplied with the JDK place too much focus on the Client-Server constraint for the exchanges of request and responses rather than a resource, identified by a URI, and the use of a fixed set of HTTP methods.

A resource in the Jersey client API is an instance of the Java class `WebResource` [<http://jersey.java.net/nonav/apidocs/2.0-m13/jersey/com/sun/jersey/api/client/WebResource.html>], and encapsulates a URI. The fixed set of HTTP methods are methods on `WebResource` or if using the builder pattern (more on this later) are the last methods to be called when invoking an HTTP method on a resource. The representations are Java types, instances of which, may contain links that new instances of `WebResource` may be created from.

7.2. Ease of use and reusing JAX-RS artifacts

Since a resource is represented as a Java type it makes it easy to configure, pass around and inject in ways that is not so intuitive or possible with other client-side APIs.

The Jersey Client API reuses many aspects of the JAX-RS and the Jersey implementation such as:

1. URI building using `UriBuilder` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/UriBuilder.html>] and `UriTemplate` [<http://jersey.java.net/nonav/apidocs/2.0-m13/jersey/com/sun/jersey/api/uri/UriTemplate.html>] to safely build URIs;
2. Support for Java types of representations such as `byte[]`, `String`, `InputStream`, `File`, `DataSource` and JAXB beans in addition to Jersey specific features such as JSON [<http://jersey.java.net/nonav/apidocs/2.0-m13/jersey/com/sun/jersey/api/json/package-summary.html>] support and MIME Multipart [<http://jersey.java.net/nonav/apidocs/2.0-m13/contribs/jersey-multipart/index.html>] support.
3. Using the builder pattern to make it easier to construct requests.

Some APIs, like the Apache HTTP client or `java.net.HttpURLConnection` [<http://docs.oracle.com/javase/1.5.0/docs/api/java/net/HttpURLConnection.html>], can be rather hard to use and/or require too much code to do something relatively simple.

This is why the Jersey Client API provides support for wrapping `HttpURLConnection` and the Apache HTTP client. Thus it is possible to get the benefits of the established implementations and features while getting the ease of use benefit.

It is not intuitive to send a POST request with form parameters and receive a response as a JAXB object with such an API. For example with the Jersey API this is very easy:

Example 7.1. POST request with form parameters

```
1 Form f = new Form();
2 f.add("x", "foo");
3 f.add("y", "bar");
4
5 Client c = Client.create();
6 WebResource r = c.resource("http://localhost:8080/form");
7
8 JAXBBean bean = r.
9     type(MediaType.APPLICATION_FORM_URLENCODED_TYPE)
10     .accept(MediaType.APPLICATION_JSON_TYPE)
11     .post(JAXBBean.class, f);
```

In the above code a `Form` [<http://jersey.java.net/nonav/apidocs/2.0-m13/jersey/com/sun/jersey/api/representation/Form.html>] is created with two parameters, a new `WebResource` [<http://jersey.java.net/nonav/apidocs/2.0-m13/jersey/com/sun/jersey/api/client/WebResource.html>] instance is created from a `Client` [<http://jersey.java.net/nonav/apidocs/2.0-m13/jersey/com/sun/jersey/api/client/Client.html>] then

the `Form` instance is POSTed to the resource, identified with the form media type, and the response is requested as an instance of a JAXB bean with an acceptable media type identifying the Java Script Object Notation (JSON) format. The Jersey client API manages the serialization of the `Form` instance to produce the request and de-serialization of the response to consume as an instance of a JAXB bean.

If the code above was written using `HttpURLConnection` then the developer would have to write code to serialize the form sent in the POST request and de-serialize the response to the JAXB bean. In addition further code would have to be written to make it easy to reuse the same resource “`http://localhost:8080/form`” that is encapsulated in the `WebResource` type.

7.3. Getting started with the Jersey client

Refer to the dependencies chapter [http://jersey.java.net/nonav/documentation/2.0-m13/chapter_deps.html#chapter_deps], and specifically the Core client [http://jersey.java.net/nonav/documentation/2.0-m13/chapter_deps.html#core_client] section, for details on the dependencies when using the Jersey client with Maven and Ant.

Refer to the Java API documentation [<http://jersey.java.net/nonav/apidocs/2.0-m13/jersey/com/sun/jersey/api/client/package-summary.html>] for details on the Jersey client API packages and classes.

Refer to the Java API Apache HTTP client documentation [<http://jersey.java.net/nonav/apidocs/2.0-m13/contribs/jersey-apache-client/index.html>] for details on how to use the Jersey client API with the Apache HTTP client.

7.4. Overview of the API

To utilize the client API it is first necessary to create an instance of a `Client` [<http://jersey.java.net/nonav/apidocs/2.0-m13/jersey/com/sun/jersey/api/client/Client.html>], for example:

```
Client c = Client.create();
```

7.4.1. Configuring a Client and WebResource

The client instance can then be configured by setting properties on the map returned from the `getProperties` methods or by calling the specific setter methods, for example the following configures the client to perform automatic redirection for appropriate responses:

```
c.getProperties().put(
    ClientConfig.PROPERTY_FOLLOW_REDIRECTS, true);
```

which is equivalent to the following:

```
c.setFollowRedirects(true);
```

Alternatively it is possible to create a `Client` instance using a `ClientConfig` [<http://jersey.java.net/nonav/apidocs/2.0-m13/jersey/com/sun/jersey/api/client/config/ClientConfig.html>] object for example:

```
ClientConfig cc = new DefaultClientConfig();
cc.getProperties().put(
    ClientConfig.PROPERTY_FOLLOW_REDIRECTS, true);
Client c = Client.create(cc);
```

Once a client instance is created and configured it is then possible to obtain a `WebResource` [<http://jersey.java.net/nonav/apidocs/2.0-m13/jersey/com/sun/jersey/api/client/>

`WebResource.html]` instance, which will inherit the configuration declared on the client instance. For example, the following creates a reference to a Web resource with the URI “`http://localhost:8080/xyz`”:

```
WebResource r = c.resource("http://localhost:8080/xyz");
```

and redirection will be configured for responses to requests invoked on the Web resource.

Client instances are expensive resources. It is recommended a configured instance is reused for the creation of Web resources. The creation of Web resources, the building of requests and receiving of responses are guaranteed to be thread safe. Thus a `Client` instance and `WebResource` instances may be shared between multiple threads.

In the above cases a `WebResource` instance will utilize `URLConnection` or `HttpsURLConnection`, if the URI scheme of the `WebResource` is “`http`” or “`https`” respectively.

7.4.2. Building a request

Requests to a Web resource are built using the builder pattern (see `RequestBuilder` [<http://jersey.java.net/nonav/apidocs/2.0-m13/jersey/com/sun/jersey/api/client/RequestBuilder.html>]) where the terminating method corresponds to an HTTP method (see `UniformInterface` [<http://jersey.java.net/nonav/apidocs/2.0-m13/jersey/com/sun/jersey/api/client/UniformInterface.html>]). For example,

```
String response = r.accept(
    MediaType.APPLICATION_JSON_TYPE,
    MediaType.APPLICATION_XML_TYPE).
    header("X-FOO", "BAR").
    get(String.class);
```

The above sends a GET request with an `Accept` header of `application/json`, `application/xml` and a non-standard header `X-FOO` of `BAR`.

If the request has a request entity (or representation) then an instance of a Java type can be declared in the terminating HTTP method, for PUT, POST and DELETE requests. For example, the following sends a POST request:

```
String request = "content";
String response = r.accept(
    MediaType.APPLICATION_JSON_TYPE,
    MediaType.APPLICATION_XML_TYPE).
    header("X-FOO", "BAR").
    post(String.class, request);
```

where the `String "content"` will be serialized as the request entity (see the section “`Java instances and types for representations`” section for further details on the supported Java types). The `Content-Type` of the request entity may be declared using the `type` builder method as follows:

```
String response = r.accept(
    MediaType.APPLICATION_JSON_TYPE,
    MediaType.APPLICATION_XML_TYPE).
    header("X-FOO", "BAR").
    type(MediaType.TEXT_PLAIN_TYPE).
    post(String.class, request);
```

or alternatively the request entity and type may be declared using the `entity` method as follows:

```
String response = r.accept(
```

```
MediaType.APPLICATION_JSON_TYPE,
MediaType.APPLICATION_XML_TYPE).
header("X-FOO", "BAR").
entity(request, MediaType.TEXT_PLAIN_TYPE).
post(String.class);
```

7.4.3. Receiving a response

If the response has a entity (or representation) then the Java type of the instance required is declared in the terminating HTTP method. In the above examples a response entity is expected and an instance of `String` is requested. The response entity will be de-serialized to a `String` instance.

If response meta-data is required then the Java type `ClientResponse` [<http://jersey.java.net/nonav/apidocs/2.0-m13/jersey/com/sun/jersey/api/client/ClientResponse.html>] can be declared from which the response status, headers and entity may be obtained. For example, the following gets both the entity tag and response entity from the response:

```
ClientResponse response = r.get(ClientResponse.class);
EntityTag e = response.getEntityTag();
String entity = response.getEntity(String.class);
```

If the `ClientResponse` type is not utilized and the response status is greater than or equal to 300 then the runtime exception `UniformInterfaceException` [<http://jersey.java.net/nonav/apidocs/2.0-m13/jersey/com/sun/jersey/api/client/UniformInterfaceException.html>] is thrown. This exception may be caught and the `ClientResponse` obtained as follows:

```
try {
    String entity = r.get(String.class);
} catch (UniformInterfaceException ue) {
    ClientResponse response = ue.getResponse();
}
```

7.4.4. Creating new WebResources from a WebResource

A new `WebResource` [<http://jersey.java.net/nonav/apidocs/2.0-m13/jersey/com/sun/jersey/api/client/WebResource.html>] can be created from an existing `WebResource` by building from the latter's URI. Thus it is possible to build the request URI before building the request. For example, the following appends a new path segment and adds some query parameters:

```
WebResource r = c.resource("http://localhost:8080/xyz");

MultivaluedMap<String, String> params = MultivaluedMapImpl();
params.add("foo", "x");
params.add("bar", "y");

String response = r.path("abc").
    queryParams(params).
    get(String.class);
```

that results in a GET request to the URI `"http://localhost:8080/xyz/abc?foo=x&bar=y"`.

7.4.5. Java instances and types for representations

All the Java types for representations supported by the Jersey server side for requests and responses are also supported on the client side. This includes the standard Java types as specified by JAX-RS in section

4.2.4 [<http://jsr311.java.net/nonav/releases/1.0/spec/index.html>] in addition to JSON, Atom and Multipart MIME as supported by Jersey.

To process a response entity (or representation) as a stream of bytes use `InputStream` as follows:

```
InputStream in = r.get(InputStream.class);
// Read from the stream
in.close();
```

Note that it is important to close the stream after processing so that resources are freed up.

To POST a file use `File` as follows:

```
File f = ...
String response = r.post(String.class, f);
```

Refer to the JAXB sample [<https://maven.java.net/service/local/artifact/maven/redirect?r=releases&g=com.sun.jersey.samples&a=jaxb&v=2.0-m13&c=project&e=zip>] to see how JAXB with XML and JSON can be utilized with the client API (more specifically, see the unit tests).

7.5. Adding support for new representations

The support for new application-defined representations as Java types requires the implementation of the same provider-based interfaces as for the server side JAX-RS API, namely `MessageBodyReader` [<http://jsr311.java.net/nonav/javadoc/javax/ws/rs/ext/MessageBodyReader.html>] and `MessageBodyWriter` [<http://jsr311.java.net/nonav/javadoc/javax/ws/rs/ext/MessageBodyWriter.html>], respectively, for request and response entities (or inbound and outbound representations). Refer to the entity provider [<https://maven.java.net/service/local/artifact/maven/redirect?r=releases&g=com.sun.jersey.samples&a=entity-provider&v=2.0-m13&c=project&e=zip>] sample for such implementations utilized on the server side.

Classes or implementations of the provider-based interfaces need to be registered with a `ClientConfig` and passed to the `Client` for creation. The following registers a provider class `MyReader` which will be instantiated by Jersey:

```
ClientConfig cc = new DefaultClientConfig();
cc.getClasses().add(MyReader.class);
Client c = Client.create(cc);
```

The following registers an instance or singleton of `MyReader`:

```
ClientConfig cc = new DefaultClientConfig();
MyReader reader = ...
cc.getSingletons().add(reader);
Client c = Client.create(cc);
```

7.6. Using filters

Filtering requests and responses can provide useful functionality that is hidden from the application layer of building and sending requests, and processing responses. Filters can read/modify the request URI, headers and entity or read/modify the response status, headers and entity.

The `Client` and `WebResource` classes extend from `Filterable` [<http://jersey.java.net/nonav/apidocs/2.0-m13/jersey/com/sun/jersey/api/client/filter/Filterable.html>] and that enables the addition of `ClientFilter` [<http://jersey.java.net/nonav/apidocs/2.0-m13/jersey/com/sun/jersey/api/client/filter/ClientFilter.html>] instances. A `WebResource` will inherit filters from its creator, which can be a

`Client` or another `WebResource`. Additional filters can be added to a `WebResource` after it has been created. For requests, filters are applied in reverse order, starting with the `WebResource` filters and then moving to the inherited filters. For responses, filters are applied in order, starting with inherited filters and followed by the filters added to the `WebResource`. All filters are applied in the order in which they were added. For instance, in the following example the `Client` has two filters added, `filter1` and `filter2`, in that order, and the `WebResource` has one filter added, `filter3`:

```
ClientFilter filter1 = ...
ClientFilter filter2 = ...
Client c = Client.create();
c.addFilter(filter1);
c.addFilter(filter2);

ClientFilter filter3 = ...
WebResource r = c.resource(...);
r.addFilter(filter3);
```

After a request has been built the request is filtered by `filter3`, `filter2` and `filter1` in that order. After the response has been received the response is filtered by `filter1`, `filter2` and `filter3` in that order, before the response is returned.

Filters are implemented using the “russian doll” stack-based pattern where a filter is responsible for calling the next filter in the ordered list of filters (or the next filter in the “chain” of filters). The basic template for a filter is as follows:

```
class AppClientFilter extends ClientFilter {
    public ClientResponse handle(ClientRequest cr) {
        // Modify the request
        ClientRequest mcr = modifyRequest(cr);
        // Call the next filter
        ClientResponse resp = getNext().handle(mcr);
        // Modify the response
        return modifyResponse(resp);
    }
}
```

The filter modifies the request (if required) by creating a new `ClientRequest` [<http://jersey.java.net/nonav/apidocs/2.0-m13/jersey/com/sun/jersey/api/client/ClientRequest.html>] or modifying the state of the passed `ClientRequest` before calling the next filter. The call to the next request will return the response, a `ClientResponse`. The filter modifies the response (if required) by creating a new `ClientResponse` or modifying the state of the returned `ClientResponse`. Then the filter returns the modified response. Filters are re-entrant and may be called by multiple threads performing requests and processing responses.

7.6.1. Supported filters

The Jersey Client API currently supports two filters:

1. A GZIP content encoding filter, `GZIPContentEncodingFilter` [<http://jersey.java.net/nonav/apidocs/2.0-m13/jersey/com/sun/jersey/api/client/filter/GZIPContentEncodingFilter.html>]. If this filter is added then a request entity is compressed with the `Content-Encoding` of `gzip`, and a response entity if compressed with a `Content-Encoding` of `gzip` is decompressed. The filter declares an `Accept-Encoding` of `gzip`.
2. A logging filter, `LoggingFilter` [<http://jersey.java.net/nonav/apidocs/2.0-m13/jersey/com/sun/jersey/api/client/filter/LoggingFilter.html>]. If this filter is added then the request and response headers as well

as the entities are logged to a declared output stream if present, or to `System.out` if not. Often this filter will be placed at the end of the ordered list of filters to log the request before it is sent and the response after it is received.

The filters above are good examples that show how to modify or read request and response entities. Refer to the source code [<https://maven.java.net/service/local/artifact/maven/redirect?r=releases&g=com.sun.jersey&a=jersey-client&v=2.0-m13&e=jar>] of the Jersey client for more details.

7.7. Testing services

The Jersey client API was originally developed to aid the testing of the Jersey server-side, primarily to make it easier to write functional tests in conjunction with the JUnit framework for execution and reporting. It is used extensively and there are currently over 1000 tests.

Embedded servers, Grizzly and a special in-memory server, are utilized to deploy the test-based services. Many of the Jersey samples contain tests that utilize the client API to server both for testing and examples of how to use the API. The samples utilize Grizzly or embedded Glassfish to deploy the services.

The following code snippets are presented from the single unit test `HelloWorldWebAppTest` of the `helloworld-webapp` [<https://maven.java.net/service/local/artifact/maven/redirect?r=releases&g=com.sun.jersey.samples&a=helloworld-webapp&v=2.0-m13&c=project&e=zip>] sample. The `setUp` method, called before a test is executed, creates an instance of the Glassfish server, deploys the application, and a `WebResource` instance that references the base resource:

```
@Override
protected void setUp() throws Exception {
    super.setUp();

    // Start Glassfish
    glassfish = new GlassFish(BASE_URI.getPort());

    // Deploy Glassfish referencing the web.xml
    ScatteredWar war = new ScatteredWar(
        BASE_URI.getRawPath(), new File("src/main/webapp"),
        new File("src/main/webapp/WEB-INF/web.xml"),
        Collections.singleton(
            new File("target/classes").
                toURI().toURL()));
    glassfish.deploy(war);

    Client c = Client.create();
    r = c.resource(BASE_URI);
}
```

The `tearDown` method, called after a test is executed, stops the Glassfish server.

```
@Override
protected void tearDown() throws Exception {
    super.tearDown();
    glassfish.stop();
}
```

The `testHelloWorld` method tests that the response to a GET request to the Web resource returns "Hello World":

```
public void testHelloWorld() throws Exception {
    String responseMsg = r.path("helloworld").
        get(String.class);
    assertEquals("Hello World", responseMsg);
}
```

Note the use of the `path` method on the `WebResource` to build from the base `WebResource`.

7.8. Security with `Http(s)URLConnection`

7.8.1. With `Http(s)URLConnection`

The support for security, specifically HTTP authentication and/or cookie management with `Http(s)URLConnection` is limited due to constraints in the API. There are currently no specific features or properties on the `Client` class that can be set to support HTTP authentication. However, since the client API, by default, utilizes `HttpURLConnection` or `HttpsURLConnection`, it is possible to configure system-wide security settings (which is obviously not sufficient for multiple client configurations).

For HTTP authentication the `java.net.Authenticator` can be extended and statically registered. Refer to the `Http authentication` [<http://docs.oracle.com/javase/6/docs/technotes/guides/net/http-auth.html>] document for more details. For cookie management the `java.net.CookieHandler` can be extended and statically registered. Refer to the `Cookie Management` [<http://docs.oracle.com/javase/6/docs/technotes/guides/net/http-cookie.html>] document for more details.

To utilize HTTP with SSL it is necessary to utilize the “https” scheme. For certificate-based authentication see the class `HTTPSProperties` [<http://jersey.java.net/nonav/apidocs/latest/jersey/com/sun/jersey/client/urlconnection/HTTPSProperties.html>] for how to set `javax.net.ssl.HostnameVerifier` and `javax.net.ssl.SSLContext`.

7.8.2. With Apache HTTP client

The support for HTTP authentication and cookies is much better with the Apache HTTP client than with `HttpURLConnection`. See the Java documentation for the package `com.sun.jersey.client.apache` [<http://jersey.java.net/nonav/apidocs/2.0-m13/contribs/jersey-apache-client/com/sun/jersey/client/apache/package-summary.html>], `ApacheHttpClientState` [<http://jersey.java.net/nonav/apidocs/2.0-m13/contribs/jersey-apache-client/com/sun/jersey/client/apache/config/ApacheHttpClientState.html>] and `ApacheHttpClientConfig` [<http://jersey.java.net/nonav/apidocs/2.0-m13/contribs/jersey-apache-client/com/sun/jersey/client/apache/config/ApacheHttpClientConfig.html>] for more details.

Chapter 8. Filters and Interceptors

Chapter 9. Message Body Workers

Chapter 10. Asynchronous Services and Clients

Chapter 11. Programmatic API for Building Resources

Chapter 12. Support for Common Media Types

12.1. JSON

TODO: Describe support for JSON (various notations/options)

12.2. XML

TODO: Describe support for XML

12.3. Multipart

TODO: Describe support for multipart

Chapter 13. Support for Server-Sent Events

Chapter 14. Security

Security information is available by obtaining the `SecurityContext` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/SecurityContext.html>] using `@Context` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/Context.html>], which is essentially the equivalent functionality available on the `HttpServletRequest` [<http://docs.oracle.com/javaee/5/api/javax/servlet/http/HttpServletRequest.html>].

`SecurityContext` [<http://jax-rs-spec.java.net/nonav/2.0-SNAPSHOT/apidocs/javax/ws/rs/core/SecurityContext.html>] can be used in conjunction with sub-resource locators to return different resources if the user principle is included in a certain role. For example, a sub-resource locator could return a different resource if a user is a preferred customer:

Example 14.1. Accessing `SecurityContext`

```
1 @Path("basket")
2 public ShoppingBasketResource get(@Context SecurityContext sc) {
3     if (sc.isUserInRole("PreferredCustomer")) {
4         return new PreferredCustomerShoppingBasketResource();
5     } else {
6         return new ShoppingBasketResource();
7     }
8 }
```

Chapter 15. WADL Support

Chapter 16. Jersey Test Framework

Chapter 17. Building and Testing Jersey

17.1. Checking Out the Source

Jersey source code is available in a Git repository you can browse at <http://java.net/projects/jersey/sources/code/show>.

In case you are not familiar with Git, we recommend reading on of the many "Getting Started with Git" articles you can find on the web. For example this DZone RefCard [<http://refcardz.dzone.com/refcardz/getting-started-git>].

Before you can clone Jersey repository you have to sign up for a java.net [<http://java.net>] account. Once you are registered, you have to add an SSH key to your java.net profile - see this article on how to do that: http://java.net/projects/help/pages/ProfileSettings#SSH_Keys_Tab

To clone the Jersey repository you can execute the following command on the command-line (provided you have a command-line Git client installed on your machine):

```
git clone ssh://<your_java_net_id>@java.net/jersey~code
```

Milestones and releases of Jersey are tagged. You can list the tags by executing the standard Git command in the repository directory:

```
git tag -l
```

17.2. Building the Source

Jersey source code requires Java SE 6 or greater. The build is based on Maven. Maven 3 or greater is recommended. Also it is recommended you use the following Maven options when building the workspace (can be set in MAVENT_OPTS environment variable):

```
-Xmx1048m -XX:PermSize=64M -XX:MaxPermSize=128M
```

It is recommended to build all of Jersey after you cloned the source code repository. To do that execute the following commands in the directory where jersey source repository was cloned (typically the directory named "jersey~code"):

```
mvn -Dmaven.test.skip=true clean install
```

This command will build Jersey, but skip the test execution. If you don't want to skip the tests, execute the following instead:

```
mvn clean install
```

Building the whole Jersey project including tests could take significant amount of time.

17.3. Testing

Jersey contains many tests. Unit tests are in the individual Jersey modules, integration and end-to-end tests are in jersey~code/tests directory. You can run tests related to a particular area using the following command:

```
mvn -Dtest=<pattern> test
```

where `pattern` may be a comma separated set of names matching tests.

17.4. Using NetBeans

NetBeans IDE has excellent maven support. The Jersey maven modules can be loaded, built and tested in NetBeans without any additional NetBeans-specific project files.

Chapter 18. Migrating from Jersey 1.x

This chapter is a migration guide for people switching from Jersey 1.x. Since many of the Jersey 1.x features became part of JAX-RS 2.0 standard which caused changes in the package names, we decided it is a good time to do a more significant incompatible refactoring, which will allow us to introduce some more interesting new features in the future. As the result, there are many incompatibilities between Jersey 1.x and Jersey 2.0. This chapter summarizes how to migrate the concepts found in Jersey 1.x to Jersey/JAX-RS 2.0 concepts.

18.1. Server API

Jersey 1.x contains number of proprietary server APIs. This section covers migration of application code relying on those APIs.

18.1.1. Injecting custom objects

Jersey 1.x have its own internal dependency injection framework which handles injecting various parameters into field or methods. It also provides a way how to register custom injection provider in Singleton or PerRequest scopes. Jersey 2.x uses HK2 as dependency injection framework and users are also able to register custom classes or instances to be injected in various scopes.

Main difference in Jersey 2.x is that you don't need to create special classes or providers for this task; everything should be achievable using HK2 API. Custom injectables can be registered at ResourceConfig level by adding new HK2 Module or by dynamically adding binding almost anywhere using injected HK2 Services instance.

Jersey 1.x Singleton:

```
ResourceConfig resourceConfig = new DefaultResourceConfig();
resourceConfig.getSingletons().add(
    new SingletonTypeInjectableProvider<Context, SingletonType>(
        SingletonType.class, new SingletonType()) {});
```

Jersey 1.x PerRequest:

```
ResourceConfig resourceConfig = new DefaultResourceConfig();
resourceConfig.getSingletons().add(
    new PerRequestTypeInjectableProvider<Context, PerRequestType>() {
        @Override
        public Injectable<PerRequestType> getInjectable(ComponentContext ic, C
            //...
    }
});
```

Jersey 2.0 HK2 Module:

```
public static class MyBinder extends AbstractBinder {

    @Override
    protected void configure() {
        // request scope binding
    }
}
```

```

        bind(MyInjectablePerRequest.class).to(MyInjectablePerRequest.class).in(RequestScoped.class);
        // singleton binding
        bind(MyInjectableSingleton.class).in(Singleton.class);
        // singleton instance binding
        bind(new MyInjectableSingleton()).to(MyInjectableSingleton.class);
    }
}

// register module to ResourceConfig (can be done also in constructor)
ResourceConfig rc = new ResourceConfig();
rc.addClasses(/* ... */);
rc.addBinders(new MyBinder());

```

Jersey 2.0 dynamic binding:

```

public static class MyApplication extends Application {

    @Inject
    public MyApplication(ServiceLocator serviceLocator) {
        System.out.println("Registering injectables...");

        DynamicConfiguration dc = Injections.getConfiguration(serviceLocator);

        // request scope binding
        Injections.addBinding(
            Injections.newBinder(MyInjectablePerRequest.class).to(MyInjectablePerRequest.class),
            dc);

        // singleton binding
        Injections.addBinding(
            Injections.newBinder(MyInjectableSingleton.class).to(MyInjectableSingleton.class),
            dc);

        // singleton instance binding
        Injections.addBinding(
            Injections.newBinder(new MyInjectableSingleton()).to(MyInjectableSingleton.class),
            dc);

        // request scope binding with specified custom annotation
        Injections.addBinding(
            Injections.newBinder(MyInjectablePerRequest.class).to(MyInjectablePerRequest.class)
                .qualifiedBy(new MyAnnotationImpl())
                .in(RequestScoped.class),
            dc);

        // commits changes
        dc.commit();
    }

    @Override
    public Set<Class<?>> getClasses() {
        return ...
    }
}

```

```
}
```

18.1.2. ResourceConfig Reload

In Jersey 1, the reload functionality is based on two interfaces:

1. `com.sun.jersey.spi.container.ContainerListener`
2. `com.sun.jersey.spi.container.ContainerNotifier`

Containers, which support the reload functionality implement the `ContainerListener` interface, so that once you get access to the actual container instance, you could call its `onReload` method and get the container re-load the config. The second interface helps you to obtain the actual container instance reference. An example on how things are wired together follows.

Example 18.1. Jersey 1 reloader implementation

```
1      public class Reloader implements ContainerNotifier {
2          List<ContainerListener> ls;
3
4          public Reloader() {
5              ls = new ArrayList<ContainerListener>();
6          }
7
8          public void addListener(ContainerListener l) {
9              ls.add(l);
10         }
11
12         public void reload() {
13             for (ContainerListener l : ls) {
14                 l.onReload();
15             }
16         }
17     }
```

Example 18.2. Jersey 1 reloader registration

```
1      Reloader reloader = new Reloader();
2      resourceConfig.getProperties().put(ResourceConfig.PROPERTY_CONTAINER_NOTIF
```

In Jersey 2, two interfaces are involved again, but these have been re-designed.

1. `org.glassfish.jersey.server.spi.Container`
2. `org.glassfish.jersey.server.spi.ContainerLifecycleListener`

The `Container` interface introduces two reload methods, which you can call to get the application re-loaded. One of these methods allows to pass in a new `ResourceConfig` instance.

You can register your implementation of `ContainerLifecycleListener` the same way as any other provider (i.e. either by annotating it by `@Provider` annotation or adding it to the `ResourceConfig` directly either using the class (using `ResourceConfig.addClasses()`) or registering a particular instance using `ResourceConfig.addSingletons()` method.

An example on how things work in Jersey 2 follows.

Example 18.3. Jersey 2 reloader implementation

```
1      public class Reloader implements ContainerLifecycleListener {
2
3          Container container;
4
5          public void reload(ResourceConfig newConfig) {
6              container.reload(newConfig);
7          }
8
9          public void reload() {
10             container.reload();
11         }
12
13         @Override
14         public void onStartup(Container container) {
15             this.container = container;
16         }
17
18         @Override
19         public void onReload(Container container) {
20             // ignore or do whatever you want after reload has been done
21         }
22
23         @Override
24         public void onShutdown(Container container) {
25             // ignore or do something after the container has been shutdown
26         }
27     }
```

Example 18.4. Jersey 2 reloader registration

```
1      Reloader reloader = new Reloader();
2      resourceConfig.addSingletons(reloader);
```

18.1.3. MessageBodyReaders and MessageBodyWriters ordering

JAX-RS 2.0 defines new order of MessageBodyWorkers - whole set is sorted by declaration distance, media type and source (custom providers have smaller priority than Jersey provided). JAX-RS 1.x ordering can still be forced by setting parameter MessageProperties.LEGACY_WORKERS_ORDERING ("jersey.config.workers.legacyOrdering") to true in ResourceConfig or ClientConfig properties.

18.2. Client API

JAX-RS 2.0 provides functionality that is equivalent to the Jersey 1.x proprietary client API. Here is a rough mapping between the Jersey 1.x and JAX-RS 2.0 Client API classes:

Table 18.1. Mapping of Jersey 1.x to JAX-RS 2.0 client classes

Jersey 1.x Class	JAX-RS 2.0 Class
<code>javax.ws.rs.client.Client</code>	<code>javax.ws.rs.client.Client</code>
<code>javax.ws.rs.client.ClientBuilder</code>	<code>javax.ws.rs.client.ClientBuilder</code>
<code>javax.ws.rs.client.WebTarget</code>	<code>javax.ws.rs.client.WebTarget</code>
<code>javax.ws.rs.core.Response</code>	<code>javax.ws.rs.core.Response</code>

The following sub-sections show code examples.

18.2.1. Making a simple client request

Jersey 1.x way:

```
Client client = Client.create();
WebResource webResource = client.resource(restURL).path("myresource/{param}");
String result = webResource.pathParam("param", "value").get(String.class);
```

JAX-RS 2.0 way:

```
Client client = ClientFactory.newClient();
WebTarget target = client.target(restURL).path("myresource/{param}");
String result = target.pathParam("param", "value").get(String.class);
```

18.2.2. Registering filters

Jersey 1.x way:

```
Client client = Client.create();
WebResource webResource = client.resource(restURL);
webResource.addFilter(new HTTPBasicAuthFilter(username, password));
```

JAX-RS 2.0 way:

```
Client client = ClientFactory.newClient();
WebTarget target = client.target(restURL);
target.configuration().register(new HttpBasicAuthFilter(username, password));
```

18.2.3. Setting "Accept" header

Jersey 1.x way:

```
Client client = Client.create();
WebResource webResource = client.resource(restURL).accept("text/plain");
ClientResponse response = webResource.get(ClientResponse.class);
```

JAX-RS 2.0 way:

```
Client client = ClientFactory.newClient();
WebTarget target = client.target(restURL);
```

```
Response response = target.request("text/plain").get(Response.class);
```

18.2.4. Attaching entity to request

Jersey 1.x way:

```
Client client = Client.create();
WebResource webResource = client.resource(restURL);
ClientResponse response = webResource.post(ClientResponse.class, "payload");
```

JAX-RS 2.0 way:

```
Client client = ClientFactory.newClient();
WebTarget target = client.target(restURL);
Response response = target.request().post(Entity.text("payload"), Response.class);
```

18.2.5. Setting SSLContext and/or HostnameVerifier

Jersey 1.x way:

```
HTTPSProperties prop = new HTTPSProperties(hostnameVerifier, sslContext);
DefaultClientConfig dcc = new DefaultClientConfig();
dcc.getProperties().put(HTTPSProperties.PROPERTY_HTTPS_PROPERTIES, prop);
Client client = Client.create(dcc);
```

Jersey 2.0 way:

```
Client client = ClientFactory.newClient();
client.configuration().setProperty(ClientProperties.SSL_CONTEXT, sslContext);
client.configuration().setProperty(ClientProperties.HOSTNAME_VERIFIER, hostnameVer
```